60/46

18

140,516

PATENT SPECIFICATION

Application Date, Dec. 23, 1918. No. 21,574/18.
Complete Left, June 13, 1919.
Complete Accepted, Mar. 23, 1920.

PROVISIONAL SPECIFICATION.

Improvements in or relating to Generators for Producing and Utilising Mixed Steam and Products of Combustion.

We, MARIO FRANCESCO TORAZZI, Engineer, of Board Street, Sandgate, Queensland, Australia, and GEORGE WILLIAM CUTLER WEBB, Engineer, of Brooklands, Dartford, in the County of Kent, do hereby declare the nature of this invention to be as follows:—

This invention relates to generators for producing and utilising mixed steam and products of combustion and provides an improved arrangement of fuel burner and generator by means of which the kinetic energy of a stream of the mixture moving at high speed may be utilised for the production of power.

According to this invention the fuel is burned under suitable pressure in a combustion chamber at or towards one end of which the burner or burners are situated while the other end opens into the mouth of a mixing chamber supplied with steam or water or both in such a manner that the hot gases from the combustion chamber convert the water (when this is used) into steam and the mixed steam and gases are projected through the mixing chamber. The combustion chamber preferably expands slightly from the burner end and then contracts to a relatively small nozzle or nozzles, the section of the combustion chamber being of a form which ensures a smooth outflow for the heated gases. The combustion chamber is preferably surrounded by an annular water chamber from which the water is supplied to the mixing chamber and the burner may be arranged to provide for mixed fuel and air and an auxiliary air supply surrounding or placed outside of the flame, this arrangement being found to produce better combustion and to enable the combustion to take place at substantial pressure. The generator may be formed with a succession of mixing chambers at each of which steam or water or both are admitted and the water when this is used converted into steam, or the steam generation and mixing may be effected by a single chamber.

In the preferred construction the burner comprises a burner nozzle supplied with mixed gas and air or a mixture of air and vapour or liquid fuel supplied at the desired pressure. Auxiliary air tubes are provided terminating at air inlet ports at the burner end of the combustion chamber a short distance in front of the end of the burner. Any number of air supply tubes may be provided arranged in ring form or two placed at opposite sides of the burner axis

[*Price* 1/-]

may be used, the air inlet ports being either tubular or expanded or, if found preferable, arranged in a ring around the combustion chamber. The combustion chamber expands from the burner end and gradually towards its maximum diameter situated nearer the nozzle end the expanding walls being straight or approximately straight; the chamber then contracts in a smooth curve but comparatively rapidly towards the constricted nozzle which enters the mouth of the mixing chamber this chamber expanding towards the middle and contracting slightly towards its outer end. The mixing chamber is preferably made in two parts connected together by the coupling ring. As already mentioned the generator may comprise a series of mixing chambers the outlet end of one entering the inlet end of the other, steam or water or both being supplied to each inlet, or the water may be forced in at some other point in the chamber, where it is converted into steam by the hot gases. In this form of generator the annular water chamber may be extended to enclose all the mixing chambers each of which after expanding from the neck contracts again to the outlet end. The nozzle end of the combustion chamber opens into the mouth of the nearest chamber and water is drawn or forced into this nozzle from the annular water chamber. The mixed steam and hot gases pass at high velocity into the mouth of the second nozzle, drawing in a further supply of water from the extension of the water chamber. The number of mixing chambers employed depends upon the water and fuel supply and the desired pressure or velocity of the mixture, the mixture or the velocity or both increasing at each chamber until all the available heat of combustion has been utilised.

Water is supplied at a regulated rate to the annular water chamber which serves both as a steam generator or water heater and to cool the combustion chamber and prevent its walls rising to too high a temperature. The flame from the burner fills the combustion chamber and when the flame strikes the water or mixed water and steam passing from the annular water chamber into the mouth of the mixing chamber it converts the water into steam, with the result that the mixed steam and gas, after expanding in the mixing chamber flow through the reduced end at very high velocity and can be utilised in a mixed gas and steam turbine or any other convenient type of prime mover connected to the generator. If a single mixing chamber is used the supply of water and steam should be such as to permit of a steam and gas mixture of suitable temperature and velocity of discharge for direct use in the prime mover, but if a succession of mixing chambers are employed the initial water supply is reduced so that hot gas and superheated steam pass through the first mixing chamber at a sufficient temperature to convert the succeeding water supplies into steam, each chamber adding to the volume and pressure of the mixture and to the velocity of discharge.

Owing to the arrangement of the combustion chamber in which the flame from the burner after expanding in the main part of the chamber is caused to contract towards the nozzle end and to pass through a very restricted opening, there is no risk of the pressure developed in the ejector causing a back rush of steam into the combustion chamber, the forward velocity due to the ejector action at the nozzle being sufficient to carry the mixture forward against a pressure substantially greater than that existing in the combustion chamber.

A construction of burner especially suited for use with this apparatus and adapted to burn liquid fuel comprises a central main air supply tube surrounded by an annular fuel space to which liquid fuel is admitted at a regulated rate and pressure, the air supply to the said tube being at substantial pressure so as to spray the fuel. In addition to the main air supply through this tube an auxiliary annular air space is provided surrounding the burner and opening slightly behind the end of the burner nozzle so that the flame from the burner is surrounded by an annular current of auxiliary air which ensures perfect combustion at a substantial pressure. The auxiliary air supply may be drawn from the main air supply tube through a by-pass provided with a regulat-

ing cock, the burner itself lying outside the combustion chamber so that any necessary adjustments may be made without disturbing the burner.

Dated this 23rd day of December, 1918.

HASELTINE, LAKE & Co.,
28, Southampton Buildings, London, England, and
55, Liberty Street, New York City, U.S.A.,
Agents for the Applicants.

COMPLETE SPECIFICATION.

Improvements in or relating to Generators for Producing and Utilising Mixed Steam and Products of Combustion.

We, MARIO FRANCESCO TORAZZI, Engineer, of Board Street, Sandgate, Queensland, Australia, and GEORGE WILLIAM CUTLER WEBB, Engineer, of Brooklands, Dartford, in the County of Kent, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to generators for producing and utilising mixed steam and products of combustion and provides an improved arrangement of fuel burner and generator by means of which the kinetic energy of a stream of the mixture moving at high speed may be utilised for the production of power.

According to this invention, the fuel is burned under suitable pressure in a combustion chamber at or towards one end of which the burner or burners is or are situated, which combustion chamber contracts towards the other end to form a relatively small inner ejector nozzle which opens into the mouth of a mixing chamber giving an uninterrupted outlet flow from the chamber and forming the outer ejector nozzle, steam or water or both being supplied in such manner that the hot gases from the combustion chamber convert the water (when this is used) into steam and mixed steam and gases are projected at high velocity through the mixing chamber and in an uninterrupted flow to the power generator. The section of the combustion chamber should be of a form which ensures a smooth outflow for the heated gases. The combustion chamber is preferably surrounded by an annular water chamber from which the water is supplied to the mixing chamber and the burner may be arranged to provide for mixed fuel and air and an auxiliary air supply surrounding or placed outside of the flame, this arrangement being found to produce better combustion and to enable the combustion to take place at substantial pressure. It has been proposed to burn fuel in a combustion chamber surrounded by a water jacket and terminating in a nozzle leading to a mixing chamber supplied with steam or water from the jacket, but such apparatus did not provide for the uninterrupted flow necessary to utilise the kinetic energy of the mixture according to this invention. The generator may be formed with a succession of mixing chambers at each of which steam or water or both are admitted and the water converted into steam, or the steam generation and mixing may be effected by a single chamber.

In order that the said invention may be clearly understood and readily carried into effect, we will describe the same more fully with reference to the accompanying drawings, in which:—

Figure 1 is a longitudinal section through a combustion chamber and mixing chamber embodying this invention.

Figure 2 is a section through a modified arrangement of burner adapted for use with the combustion chamber; and

Figure 3 is a diagram showing a succession of mixing chambers,

A is the combustion chamber. B is the mixing chamber. C is an annular water chamber surrounding the combustion chamber A and provided with a water inlet *c*. D is the burner.

Referring to Figure 1, the end of the burner only is shown, comprising a burner nozzle supplied with mixed gas and air or a mixture of air and vapour or liquid fuel supplied at the desired pressure. *d*, *d* are auxiliary air tubes terminating at the air inlet ports *a* at the burner end of the combustion chamber A, a little in front of the end of the burner D. Any number of air supply tubes *d* may be provided arranged in ring form or two placed at opposite sides of the burner axis may be used, the ports *a* being either tubular or expanded or, if found preferable arranged in a ring around the chamber A.

The combustion chamber expands from the burner end gradually towards its maximum diameter situated nearer the nozzle end a^1, the expanding walls being straight or approximately straight, the chamber then contracting in a smooth curve but comparatively rapidly towards the constricted nozzle a^1 which enters the mouth *b* of the mixing chamber B, this chamber expanding towards the middle and contracting slightly towards its outer end. The chamber is shown as made in two parts connected together by the coupling ring b^1. As already mentioned, the generator may comprise a series of chambers, the outlet end of one entering the inlet end of the other, steam, water or both being supplied to each inlet.

Water is supplied at a regulated rate to the annular water chamber C through the inlet *c* and the water chamber serves both as a steam generator or water heater and to cool the combustion chamber and prevent its walls rising to too high a temperature. The flame from the burner fills the combustion chamber, and when the flame strikes the water or mixed water and steam passing from the annular chamber C into the mouth of the mixing chamber, it converts the water into steam, with the result that the mixed steam and gas, after expanding into the chamber B, flow through the reduced end at very high velocity and can be utilised in a mixed gas and steam turbine or any other convenient type of prime mover connected to the generator. If a single mixing chamber is used, the supply of water and steam should be such as to permit of a steam and gas mixture of suitable temperature and velocity of discharge for direct use in the prime mover, but if a succession of mixing chambers are employed (as in Figure 3) the initial water supply is reduced so that the hot gases and superheated steam pass through the first mixing chamber at a sufficient temperature, to convert the succeeding water supplies into steam.

Owing to the arrangement of the combustion chamber, in which the flame from the burner after expanding in the main part of the chamber is caused to contract towards the nozzle end and to pass through a very restricted opening, there is no risk of the pressure developed in the ejector causing a back rush of steam into the combustion chamber, the forward velocity due to the ejector action at the nozzle being sufficient to carry the mixture forward against a pressure substantially greater than that existing in the combustion chamber.

In Figure 2 a construction of burner especially suited for use with this apparatus and adapted to burn liquid fuel is illustrated, the burner comprising a central main air supply tube d^1 surrounded by an annular fuel space d^2 to which liquid fuel is admitted through the inlet d^3 at a regulated rate and pressure, the air supply to the tube d^1 being at substantial pressure so as to spray the fuel. In addition to the main air supply through the tube d^1 an auxiliary annular air space d^4 is provided surrounding the burner and opening slightly behind the end of the burner nozzle so that the flame from the burner is surrounded by an annular current of auxiliary air which ensures perfect combustion at a substantial pressure. The auxiliary air supply may be drawn

from the main air tube d^1 through the by-pass d^5 provided with a regulating cock d^6 the burner itself lying outside the combustion chamber A so that any necessary adjustments may be made without disturbing the burner.

In the multiple chamber modification shown diagrammatically in Figure 3, the annular water chamber C is extended at C^1 to enclose a succession of chambers B^1, each of which after expanding from the neck b^2 contracts again to the outlet end b^3. The nozzle end a^1 of the combustion chamber opens into the mouth of the nearest chamber B^1 and water is drawn or forced into this nozzle from the annular chamber C. The mixed steam and hot gases pass at high velocity into the mouth of the second nozzle, drawing in a further supply of water from the extension C^1 of the water chamber. The number of chambers B^1 employed depends upon the water and fuel supply and the desired temperature and pressure or velocity of the mixture.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:—

1. A mixed steam and products of combustion generator in which fuel is burned under suitable pressure in a combustion chamber at or towards one end of which the burner or burners is or are situated, which combustion chamber contracts towards the other end to form a relatively small inner ejector nozzle which opens into the mouth of a mixing chamber giving an uninterrupted outlet flow from the chamber and forming the outer ejector nozzle, steam or water or both being supplied in such a manner that the hot gases from the combustion chamber convert the water (when this is used) into steam and mixed steam and gases are projected at high velocity through the mixing chamber and in an interrupted flow to the power generator.

2. A mixed steam and products of combustion generator as claimed in Claim 1 in which a burner arranged to burn fuel under pressure is fitted at one end of a combustion chamber first expanding and then contracting to a restricted ejector nozzle entering the mouth of the mixing chamber, the combustion chamber being surrounded by a water chamber supplied with water at a regulated rate and opening into the mixing chamber around the ejector nozzle of the combustion chamber, for the purpose specified.

3. A mixed steam and products of combustion generator as claimed in Claim 1, in which a burner adapted to burn a fuel mixture under pressure is provided with an auxiliary air supply (which may be obtained through a bye-pass from the main air supply) producing a flow of air surrounding the flame which burns in the combustion chamber under pressure, for the purpose specified.

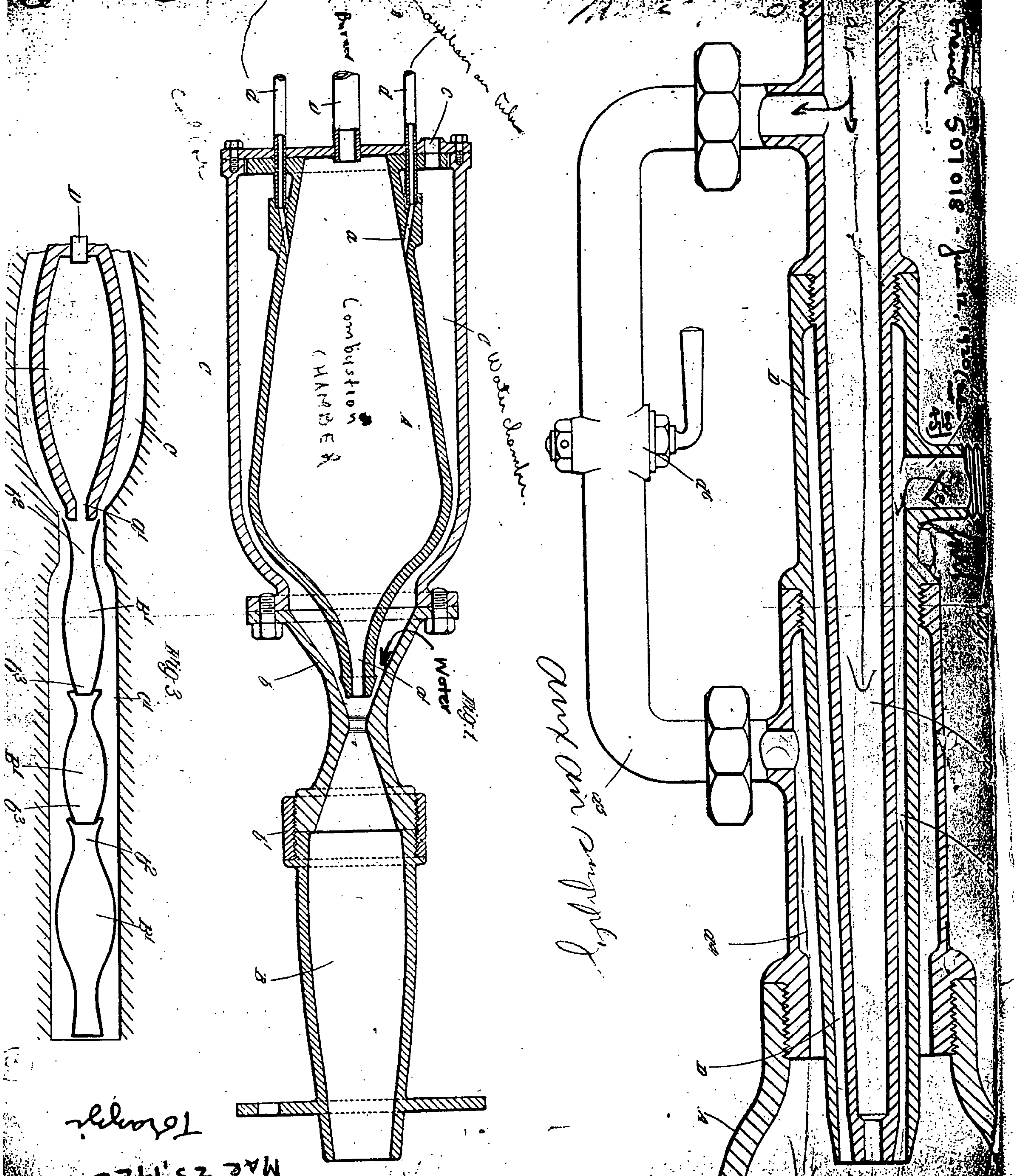
4. A mixed steam and products of combustion generator, having its parts arranged and adapted to operate substantially as hereinbefore described with reference to either of the examples illustrated in the accompanying drawings, for the purpose specified.

Dated this 13th day of June, 1919.

HASELTINE, LAKE & Co.,
28, Southampton Buildings, London, England, and
55, Liberty Street, New York City, U.S.A.,
Agents for the Applicants.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1920.

60-39.58



BRITISH 140,316
MAR 23, 1920
Toloujie